DESCRIPTION OF A NEW SPECIES OF HELICARION (STYLOMMATOPHORA: HELICARIONIDAE) IN TASMANIA

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ABSTRACT

A species Helicarion rubicundus is described. Comparative data on south eastern Australian species are presented. This paper is part of a study of the genus Helicarion in Australia.

INTRODUCTION

Previous studies of the genus Helicarion in Australia have been brief. Material is still lacking from some areas in Tasmania. Some anatomical data have been presented by Hedley (1891) for Helicarion cuvieri Ferussac. The genus is one of slug-like animals characterised by a reduced shell consisting entirely of conchin. The genotype, Helicarion cuvieri, was illustrated by Ferussac (1819) and later established in the description (1821) of the species and genus.

It is important to realise that in the complex Helicarionidae the complete review may require many years. But a study of genus Helicarion is in preparation by one of us (R.C.K.). A considerable number of animals already studied has facilitated the completion of this paper.

The genus is represented in south eastern Australia by several species:

- Helicarion cuvieri Ferussac, 1821; southern Tasmania. Helicarion niger (Quoy & Gaimard, 1832); Gippsland, Victoria. Helicarion freycineti Ferussac, 1821; eastern New South Wales.

The species Helicarion virens (northern New South Wales) together with other northern forms placed in various genera by 1redale (1937) require further study. Many forms occurring in south eastern Australia have been compared with the species described here but discussion is beyond the scope of this paper.

ACKNOWLEDGEMENTS

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DESCRIPTIONS

The genus Helicarion Ferussac is recognised by H. & A. Adams (1858) as of rotundly oval heliciform fragile shells with thin epidermis, short spire and large aperture. The mantle has accessory lobes (lappetts) of which the right posterior frequently partly covers the shell. The foot is posteriorly truncate with a recessed caudal gland. Tryon (1884) noted the swollen body whorl, oblong triangular aperture, the inability of the animal to withdraw fully within the shell and the tripartite foot sole. Gray (1855) notes the elongate neck and the imperforate shell. A summary of various aspects was provided by Smith (1972) together with a figure. Solem (1966) presented a classification of the family Helicarionidae. He includes genus Helicarion in a subfamily Helicarioninae. Some discussion of anatomical data are presented by Van Mol (1973).

Helicarion rubicundus, sp. nov. (Plate 1)

Diagnosis

Helicarionid snail with thin transparent large depressedly globose shell composed of conchin, yellowish, spire flatly convex, imperforate, aperture large, animal banded red with tail dorsally green, caudal mucus red.

Etymology

The name *rubicundus* is chosen to draw attention to the red verrucose bands observed in the live animal.

Description

Shell (see Plate 2) of three and one-half whorls, suture barely depressed. Protoconch about one and one-half whorls increasingly convex with growth, sculpture very faint low rounded radial riblets almost obsolete at lower suture relatively bold above crossed by extremely fine close spiral faintly beaded lirae. Adult sculpture passes smoothly through juvenescent stage coincident with clear widening of whorl and increasing strength until radial ribs distinctly bolder occasionally sharpened. After about two and one-quarter whorls an occasional rib is clearly raised and sharpened. The surface develops undulations broadening with growth displaying subsidiary close fine radial riblets and primary radials become increasingly curved from the sutures. Sutural margin distinct flattened or slightly depressed, supra-sutural, clearly sculptured with radial slightly curved oblique rounded ribs. Whole shell sculpture crossed by very close spiral lirae fainter toward periphery, body whorl with beading weakly visible near suture.

Animal with red verrucose bands radiating from the mantle to foot margin, tentacles red, lappetts and dorsal keel of tail green, foot fringed red. Central portion of tripartite foot sole smoothish, lateral sections with numerous transverse deeply incised tubercles, broadest below visceral

region rounded anteriorly tapering posteriorly, the central portion depressed and tapering regularly posteriorly to less than one-eighth the width at tail. Laterally foot with clearly defined slightly protruding margin at least 1 mm thick, darker coloured than pinkish sole, marked with regular vertical tubercles. In a shell of dimensions 16 mm maximum, 14.5 mm minimum, the elongate left shell lappett stretches diagonally one-third the distance across the surface with dimensions 14 mm by 9 mm greatest at mantle attachment. Right shell lappett capable of covering the apex of the shell to almost one-half surface diameter attached to mantle just posterior to pneumostome, resting slightly diagonally across shell on to tail with maximum dimensions 16 mm by 9 mm over apex tapering to about 4 mm at the posteriorly tubular fold, anteriorly attached to mantle for 10 mm. Anterior from pneumostome a distinct body lappett of 3 mm maximum width is attached over 9 mm. Lappetts attach to mantle above a distinct collar about 7 mm diameter from which mantle extends 5 mm along neck and laterally 4 mm from pneumostome edge. Optical tentacles situate 2.5 mm from pinkish smooth muzzle, about 1.5 mm apart in average animal, inferior tentacles arise immediately above lateral extremity of foot just to rear of muzzle. Genital atrium aperture immediately below right optical tentacle, penis protruding from supra-nosterior side of aperture closures tubular pink at least 6.5 from supra-posterior side of aperture, elongate tubular pink at least 6.5 mm long by 3 mm diameter extended from atrium. Pneumostome situate between mantle and ridge of lappett, subtriangular, about 4.5 mm across bright pink posterior extremity, surrounded by paler glandular area. Foot elongate quadrangular flattened behind visceral hump where laterally sub-keeled, tapering to delta shape over last one-quarter of tail to small but prominent caudal horn above caudal mucus gland (foss). Whole body covered with irregular tubercles increasing in size posteriorly from tentacles, irregular very large at posterior dorso-lateral edges, tubercles covered with close minute pustules.

Anatomy

Pharynx short compact, jaw bright orange clearly visible when muzzle protruded, arched above buccal aperture, arcuate with small central projection, triangular in cross section, tapering acutely to rounded extremities, dimensions 2 mm by 0.4 mm. Radula formula slightly variable, usually 80-18-1-18-80 of about 120 rows. In one example the rachidian was absent, in others one less lateral and two or three fewer marginals can occur. Rachidian tricuspid, mesocone elongate, gently curved to rounded tip. Ectoconal cusps set almost half way posteriorly, sharply pointed forward. Lateral teeth with elongate mesocone, a minute endoconal cusp about one-third distance from tip pointing centrally, a well developed sharpened laterally forward pointing ectoconal cusp parallel with ectoconal cusps of central tooth. A well marked cusp like projection facing the central tooth at the posterior one-third of the laterals marks the raised curved anterior portion of the tooth as distinct from the base. Marginal teeth bicuspid clearly curved slender with the ectocone situate posteriorly from mesocone. Rachidian base plate anteriorly broad, thickened, lateral aspects with central concave curve. Lateral base plates elongate smoothly distinctly convexly curved toward rachidian (Plates 3 - 5).

Reproductive System (Figure 1)

Penial complex with penis compressed distinctly at base. Epiphallus (EP) terminally laterally twisting to ephiphallic gland (EG; sinuate appendage of Solem, 1966, part of flagellum) at insertion of vas deferens (VD). Surface of gland ornamented with up to 10 rows of variable raised protruberances proximally, few at epiphallic junction (Figure 1b). Gland internally an elongate moderately capacious lumen extending from vas deferens insertion adjacent distal protruberances passing into small pockets corresponding with spermatophore spines, curving into very short sinuation of flagellum (Q). Epiphallic duct with longitudinal minutely interrupted pilasters converging at retractor muscle (RM), from which penial duct lined with lateral folds to constriction, the whole within a muscular integument. At constriction (junction of evertible section) duct enclosed within muscular walls from where a strongly contorted pilaster-like

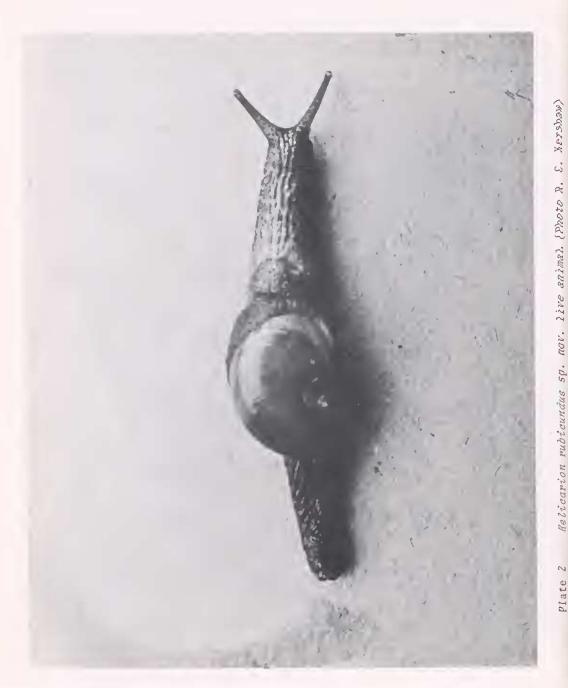
structure (Figure 1c) extends into base of penis and terminates in a very small bulging rounded verge (VE). Penial duct lined with lamellate transverse ridges thickly enclosed within elongate muscular tissue. Penial sheath distinct thickened at base, connected by a slim sheath retractor 3 mm from atrium to retractor caecum across epiphallus. Retractor caecum (RC) small distinct abruptly curved, about 1.5 mm long, 1 mm diameter, passing into penial retractor (RM). Epiphallus may be sharply recurved at caecum or smoothly curved with sheath retractor drawn tightly across. Penis 6-7 mm long from atrium to constriction (Figure 1c), on longitudinal section a purplish fluid spread rapidly staining adjoining tissue. Dart sac (or sarcobelum of Van Mol, 1973) absent. Spermatophore (Figure 2) head with a single coil and 12 branching spines in 3 groups, a plump (0.4 mm) short (3 mm) 'head' with a long (8 mm) 'tail'. Bursa copulatrix (Figure 1, SP; spermatheca of Hedley, 1891) connected to vagina by a short 2 mm external diameter muscular pedicel expanding rapidly but variably into centrally or sub-centrally swollen chamber from which the organ is angled and pointed posteriorly, variably like a high heeled boot. Internally bursa is lined densely with thin zig zag pilasters (some straight) closely spaced. Initial section of pedicel duct about one-fifth of length, lined with close pilasters opens to small vestibule from which duct, lined with larger distinct pilasters widens abruptly into bursa chamber. Vagina (VA) a short (5 mm) narrow muscular organ lined with longitudinal pilasters leading to bursa duct, becoming a moderately inflated post-uterine oviduct curving sharply from vagina to very short thin duct connecting with uterus. Spermoviducal complex (Figure 1, OD) of two ducts closely appressed, the uterine section (H) elongate swollen pale grey in tight large folds, internally duct wide thin; prostate section (E) relatively narrow thin spongelike. Initial section from post-uterine duct strongly convoluted with prostate terminating on second arm of convolution. Vas deferens (VD) a strongly contorted flattened duct with numerous folds firstly, passes from prostate across vagina to insert with epiphallic gland adjacent to on proximal aspect of distal bulges, opposite curve of sinuation, about halfway between flagellum tip and retractor muscle. Bursa copulatrix in situ rests dorsally on spermoviducal complex attached with connective tissue. Uterine section swollen at junction with bright yellow bilobately produced bulbous albumen gland (AG). Hermaphrodite duct (HD) fine strongly convoluted inserting laterally or posteriorly between lobes of albumen gland where it gives off a fine duct to talon. Talon (T) a small elongate oval dark body (0.8 mm by 0.5 mm) embedded within tissue of gland dorsolaterally from duct. Hermaphrodite gland (HG) of irregular alveoli arranged on 3 ducts, claw-like, embedded within digestive gland just below apical whorl attached to visceral wall by central duct. The talon in Helicarion is described by Van Mol (1973).

Digestive Complex (Figures 3-4)

Buccal mass about 5 mm long with retractors leading from subterminal posterior to attach ventro-laterally, to oesophagus across narrow neck of gullet. Oesophagus (AE) commonly inflated at first, then narrowing abruptly before entering muscular crop (C) and stomach (S) to digestive gland (NG). Posterior oesophageal duct (figure 4, PE) very long, about 38 mm, coiled through lobes of digestive gland to rectal duct (R) ultimately opening at anus on dorsal aspect just within pneumostome vestibule (PA). Visceral mass (V) set basally in enlarged body cavity. Digestive gland bilobate leading from apical whorl over stomach as an elongate flap appressed above and between coil of oesophagus with inferior lobe a narrow flap appressed alongside posterior oesophagus to rectal duct. Kidney (KD) on dorsal aspect of viscera, somewhat triangular with a rounded apex curving above oesophagus. Ureter arising from recurved primary uretal lobe of kidney passing toward lateral curve of oesophagus then recurved and appressed to rectal duct. Heart (HT) antero-laterally adjacent to and partly overlapped by kidney. Circumoesophageal ganglionic complex distinctly posterior to buccal mass resembling that in other Stylomatophoran groups.



Plate 1 Holotype of Helicarion rubicundus sp. nov. (Photo P. Boyer)



Helicarion rubicundus sp. nov. live animal (Photo R. E. Kershaw)

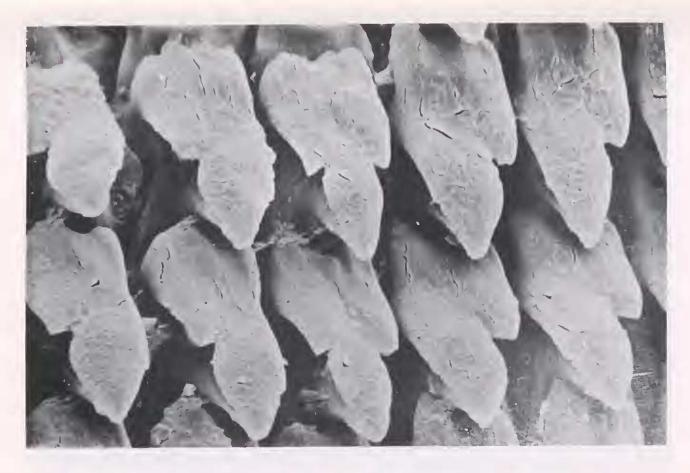


Plate 3 Helicarion rubicundus sp. nov. central and marginal teeth.

(Plate enlarged from SEM micrograph provided by Dr. B. J. Smith, National Museum of Victoria.)

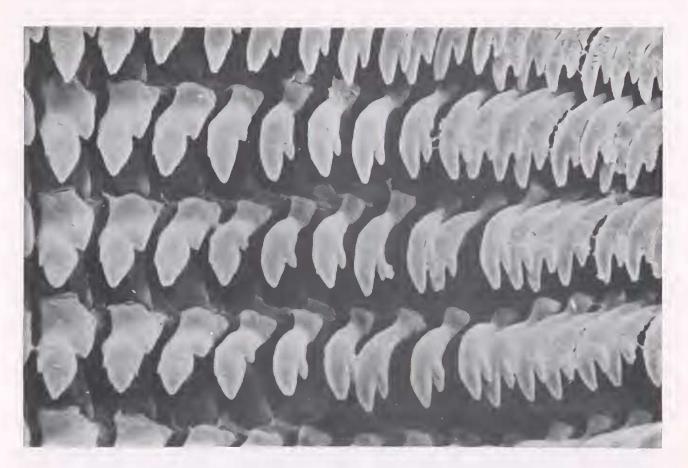


Plate 4 Helicarion rubicundus sp. nov. lateral and marginal teeth.

(Plate enlarged from SEM micrograph provided by Dr. B. J. Smith, National Museum of Victoria)

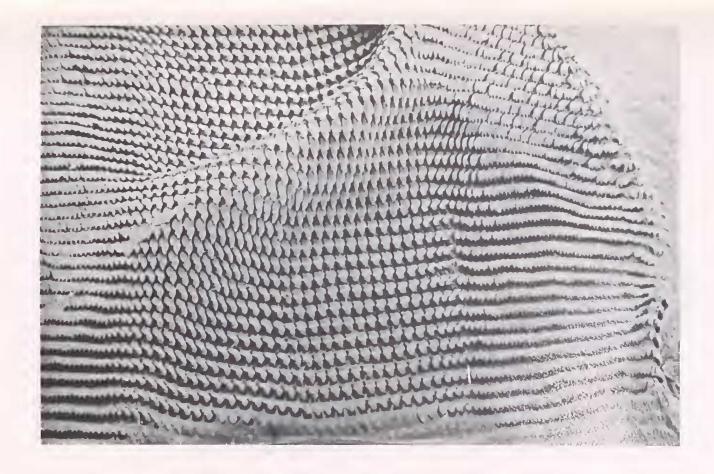


Plate 5 Helicarion rubicundus sp. nov. section of radula.

(Plate enlarged from SEM micrograph provided by Dr. B. J. Smith, National Museum of Victoria)

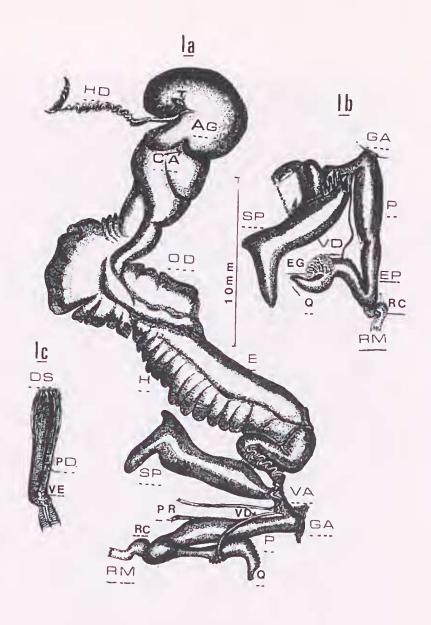


Figure 1 a Reproductive system of Helicarion rubicundus sp. nov.

1 b Detail of genital complex.

1 c Section through the penis.

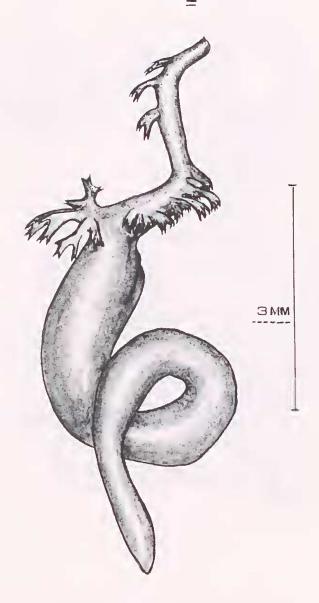


Figure 2 Spermatophore of Helicarion rubicundus sp. nov.

Figure 3 a Digestive system of Helicarion rubicundus sp. nov. 3 b Animal with shell and lappetts removed.

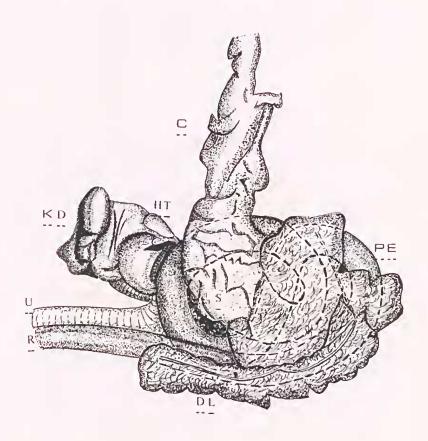


Figure 4 Digestive gland partly removed to show detail.

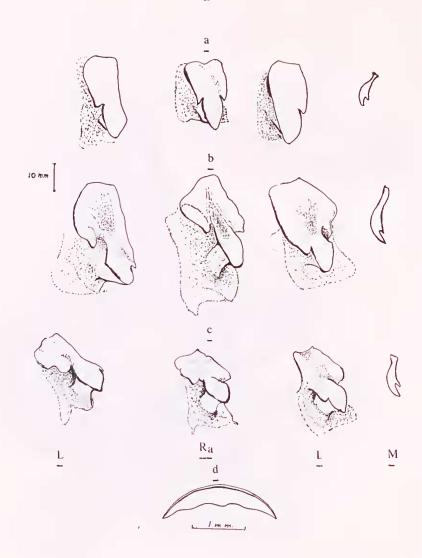


Figure 5 Comparison of radula teeth (tracings from SEM micrographs).
Scale of photographs shown.

- 5 a $\it Helicarion\ rubicundus\ sp.\ nov.:\ magnification\ of\ central\ and\ lateral\ teeth\ 800\ x,\ marginal\ tooth\ 400\ x.$
- 5 b Helicarion cuvieri Fer.: magnification of central and lateral teeth 2000 x, marginal tooth 720 x.
- 5 c Helication niger(Q ξ G): magnification of central and lateral teeth 1500 x, marginal tooth 780 x.
- 5 d Helicarion rubicundus sp. nov.: jaw.

Type Material

Holotype: Tasmanian Museum reg. no. E 9028 from litter in a fern gully on the north-east flank of Hawkes Hill near Eagle Hawk Neck, south-east Tasmania. Grid reference 575800ME 5238400MN, Storm Bay 1:100 000. Collected A. J. & J. A. Dartnall, August 1971; entire animal preserved in alcohol. Paratypes: two specimens Tasmanian Museum reg. no. E 9029, two specimens Queen Victoria Museum, Launceston, no. 1975/9/1, two specimens National Museum of Victoria no. F 29517. Collected under litter, wood and stones in fern gully, Eagle Hawk Neck by A. J. Dartnall and R. C. Kershaw, 10 June, 1973 and by R. C. Kershaw, 26 April 1974, between 40 m and 200 m above sea level.

Dimension of Type Shells (mm)

	Maximum	Minimum	Approx. foot length (preserved)
Holotype E 9028	16.5	12.5	38.0
Paratypes E 9029 a b 1975/9/1 a b F 29517 a	18.0 18.0 22.0 12.0 15.3	13.5 13.0 16.0 10.0 12.5 12.5	31.0 27.5 45.0 31.0 31.0 27.5

VARIABILITY IN H. rubicundus

Variations observed relate to the maturity of the animal and genital organs. Some variation apparently occurs in inflation of the anterior oesophagus but this feature, not seen in other forms of the genus in Tasmania or Victoria, could not be evaluated. Slight shell variations include a more clearly defined protoconch, smoother adult sculpture, fine spiral lirae so close as to resemble striae. The clearly thickened aperture lip in some cases suggests that boldly raised ribs seen may be growth stages. These, approximating ten, are spaced further apart with age.

INTERSPECIFIC CHARACTERISTICS

1. Shell Size

H. rubicundus attains a diameter of up to 22 mm, H. cuvieri up to 16 mm, H. niger up to 13 mm, and H. freycineti to 19 mm in specimens observed to date. The spirally beaded protoconch sculpture is unlike any other morph yet studied. That of H. cuvieri consists of fine variable radial lirae with vague spirals, H. niger has very fine distinct spiral striae and H. freyeineti has weak radial lirae with vague spirals a little like H. cuvieri. Shell colour is variable with most morphs yellowish or variously orange or greenish tinted. Shell sculpture is of value only as a guide due to the considerable variation. Features quoted are those most likely to be encountered.

2. Body Colour

H. rubicundus: red and green.

H. cuvieri: grey, greyish buff or white.

H. niger: black, greyish or pinkish buff often with darker extremities. H. freycineti: buff.

3. Caudal Mucus Colour

H. rubicundus: red. H. cuvieri: yellow.

4. Anatomy

Helicarion rubicundus is distinguished immediately by the presence of the small retractor caecum. Other Tasmanian forms have a very small section of the retractor which could constitute a degenerate or primitive caecum, a comment applicable to Victorian forms studied. H. rubicundus has the epiphallus from the epiphallic gland to the retractor lined with distinct pilasters, H. cuvieri has distinct pilasters to penial constriction, and in H. niger the ridges are of minute but distinct folds. There is no verge in H. cuvieri, H. rubicundus has a small rounded verge while H. niger has a small fleshy ridge. The vas deferens insertion in H. rubicundus is about half-way between flagellum tip and retractor muscle at a point about three-quarters length of flagellum, H. cuvieri about one-third the first and three-fifths to three-quarters the second section and H. niger less than one-third the first and three-quarters to nine-tenths the second section. H. freyeineti differs completely in both the retractor caecum and flagellum. There is some resemblance in the caecum of H. virens as understood at present but none in the flagellum. The new species is distinct from Tasmanian and Victorian morphs in its pink penis, bright yellow albumen gland, distinctive bursa copulatrix and the oesophagus. No other form yet dissected has the distinct convolution at the spermoviduct-vaginal junction.

THE RADULA

Comparative tracings of the central, adjacent lateral and one marginal, teeth of H. rubicundus (Figure 5a), H. cuvieri (Figure 5b; Strathgordon Road) and H. niger (Figure 5c; Sandy Point, Waratah Bay, Victoria). The teeth of the new species are twice the size of the others, the rhachidian is relatively broad with the mesocone not narrowly elongate and posteriorly excavated as in H. cuvieri. The mesocone in H. niger is relatively broader and posteriorly depressed. Cusps are very pronounced in the new species. Despite wear in the teeth of H. cuvieri the distinctive shape and features distinguish it from the new species and all other species so far studied.

DISTRIBUTION

Helicarion rubicundus is known only from the type locality. The limits of distribution will need considerable research but it is not expected to extend beyond the region. The forest floor of the habitat is well covered with litter, the overhead canopy moderately dense. The snail favours moss covered logs on which its remarkable colouration provides some camouflage. Collecting has extended the original area down the hill-slope to the creek bank and under bark of a felled log. Helicarion cuvieri is confined to southern Tasmania as at present recognised. Distinct morphs exist in the highlands of the west, central and eastern regions and the lower levels of the north and Tamar Valley. Detailed work on these is in progress. Helicarion niger as at present recognised extends from Port Philip Bay to Wilsons Promontory and possibly into the Great Divide in Victoria. The study of other morphs in Victoria is also well advanced. It has not been established that H. niger exists in Tasmania and black animals thought to be this species differ in detail of the genitalia.

The new Tasmanian species is associated with Caryodes dufresnii, Strangesta lampra, rare Tasmaphena sinclairi and various endodontids.

It is hoped that the habitat will remain as undisturbed as possible because the known distribution is restricted.

DISCUSSION

The list by Iredale (1937) has provided a useful reference source. The relationships of his genera within Australia and adjacent regions remain to be dealt with in detail. Solem's (1966) work in Thailand has been invaluable in the current research into *Helicarion* with particular reference to taxonomy. Other fruitful work could be done in chromatographic investigation of caudal mucus constituents. The new species exudes mucus when irritated. Allan (1950) reported that *Parmavitrina planilabris* exuded purple mucus. Stimulation leads to evasive action and Hyman (1967) reports that the tail may break and then regenerate. A specimen with a truncated tail has been observed by R. C. Kershaw.

Studies by A. J. Dartnall in the South Australian Museum revealed that of seven shells in the May collection (reg. no. d 11312) four resemble H. rubicundus. Shell study suggests that Luinarion castaneus (Pfeiffer) has a distinct protoconch but in general the shell requires care in use for identification.

Current studies by R. C. Kershaw suggest that Helicarion may have reached Tasmania during the pre-Miocene Tertiary. These snails are at the southern limit of family distribution in Australia. Speciation in Tasmania would have been facilitated by the isolation during the Miocene when, also, the habitat of H. rubicundus may have been isolated. The features of this snail which are reminiscent of New South Wales forms and its size suggest that it is both relict and favoured by its habitat. The remarkable uniformity of the species suggests no interbreeding with H. cuvieri although this snail has been found not far away. The Bass Strait land bridge may have enabled exchange between the two southern states and island forms exhibit relationships which remain to be fully evaluated.

The absence of the rachidian tooth in one specimen of H. rubicundus is of interest. Solem (1959, p. 45) remarks on the basic nature of the possession of this tooth to the pulmonates. It is reduced or absent in specialised genera. Although the Helicarionidae appear to show specialisation it would be unrealistic to draw conclusions from this isolated case.

LIST OF ABBREVIATIONS USED IN THE FIGURES AND TEXT

AE	anterior oesophagus	MF	caudal foss spermoviducal complex
AG	albumen gland	OD	
AP	apex	P	penis
BM	buccal mass	PA	pneumostome
C	crop	PD	penial duct
CA	carrefour	PE	posterior oesophagus
CH	caudal horn	PR	penial sheath retractor
CG	cerebral ganglia	Q	flagellum
DG	digestive gland	R	rectum
DL	lobe of digestive gland	Ra	central tooth
DS	dissected penis	RC	retractor caecum
E	prostate	RM	penial retractor
EP	epiphallus	S	stomach
EG	epiphallic gland	SP	bursa copulatrix
GA	genital atrium	T	talon
H	uterus	TA	tentacles
HD	hermaphrodite duct	U	ureter
HT	heart	V	viscera
KD	kidney	VA	vagina
L	lateral tooth	VE	verge
M	marginal tooth	VD	vas deferens

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